

CLAIMS

What is claimed is:

1. A modulator/demodulator system comprising:
 - a transmission system which applies one of a plurality of time scales and one of a plurality of time delays to one of a pair of substantially matched base signals, combines the time scaled and time delayed base signal with the other one of the pair of base signals to form a doublet, and transmits the doublet; and
 - a receiving system which receives the doublet and extracts information from the doublet based on the one of the plurality of time scales and the one of the plurality of time delays which were applied.
2. The system as set forth in claim 1 wherein the transmission system further comprises:
 - a signal generator which generates the pair of substantially matched base signals;
 - an encoding system which modulates the one of the plurality of time scales and the one of the plurality of time delays onto the one of the pair of substantially matched base signals;
 - a combiner which combines the time scaled and time delayed base signal with the other one of the pair of base signals to form the doublet; and
 - a transmitter which transmits the doublet.
3. The system as set forth in claim 1 wherein the transmission system has a plurality of doublets with an independent one of a plurality of the time scales and independent one of the plurality of time delays applied to each of the doublets, the transmission system combines all of the doublets to form and transmit a composite signal; and
 - wherein the receiving system receives the composite signal and extracts the information from each of the doublets that comprise the composite signal based on the respective one of the plurality of time scale and the one of the plurality of time delay that were applied to each of the doublets.

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4. The system as set forth in claim 2 wherein the transmission system further comprises a pair of synchronized and spatially separated radiating elements, one radiating element radiates one of the substantially matched base signals and the other radiating element radiates the time scaled and time delayed base signal; and

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wherein the receiving system further comprises a device that time scales a received signal by the time scale that was applied by the transmission system to form a time scaled version of the received signal, a correlator that correlates the received signal with the time scaled version of the received signal to form a time delay correlation signal, a detector that detects the peaks of this time delay offset correlation signal, and an estimator that uses the time delay offset locations of the peaks to estimate the angle of arrival of each of the received signals.

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5. The system as set forth in claim 1 wherein the at least one of the pair of substantially matched base signals contains the information and the receiving system extracts the information from the at least one of the pair of substantially matched base signals in the doublet.

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6. The system as set forth in claim 2 wherein the combiner is an adder or a subtractor.

7. The system as set forth in claim 1 wherein the transmission system further comprises:

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a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signal; and
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a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals.

8. The system as set forth in claim 1 wherein the information comprises a message embedded by the transmission system.

9. The system as set forth in claim 1 wherein the information 5 comprises imaging data embedded by an environment in which the doublet was transmitted.

10. The system as set forth in claim 1 wherein the receiving system further comprises:

10 a segmentation device that receives the doublet and forms received segments from the received doublet;

15 a time scaling device which applies at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;

15 a time delaying device which applies at least one of the plurality of time delays to each of the received segments to form time delayed signal segments;

20 a multiplier which multiplies each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals;

20 an integrator which integrates the multiplied signals across time to form detection signals; and

25 a processing system which compares the detection signals at different ones of the plurality of time scales and different ones of the plurality of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the information from the detection signal.

11. The system as set forth in claim 10 wherein the receiving system further comprises:

30 a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals; and

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a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals.

5 12. A modulation/demodulation method comprising:
 applying one of a plurality of time scales and one of a plurality of time delays to one of a pair of substantially matched base signals;
 combining the time scaled and time delayed base signal with the other one of the pair of base signals to form a doublet;
10 transmitting the doublet into the environment;
 receiving the doublet; and
 extracting information from the doublet based on the one of the plurality of time scales and on the one of the plurality of time delays which were applied.

15 13. The method as set forth in claim 12 further comprising:
 radiating one of the substantially matched base signals from one of a pair of synchronized and spatially separated radiating elements;
 radiating the time scaled and time delayed base signal from another
20 one of the pair of synchronized and spatially separated radiating elements;
 time scaling a received signal by the time scale that was applied to form a time scaled version of the received signal;
 correlating the received signal with the time scaled version of the received signal to form a time delay correlation signal;
25 detecting the peaks of this time delay correlation signal; and
 using the time delay locations of the peaks to estimate the angle of arrival of each of the received signals.

30 14. The method as set forth in claim 12 further comprising providing a plurality of doublets with each of the doublets having an independent one of the plurality of time scales and an independent one of the plurality of time delays applied to each of the doublets, combining all of the doublets to form a composite signal transmitting the composite signal into the environment, receiving the

composite signal, and extracting the information from the doublets that comprise the composite signal based on the respective one of the plurality of time scales and one of the plurality of time delays which were applied to each of the doublets.

5 15. The method as set forth in claim 12 further comprising imbedding information in one of the pair of substantially matched base signals in the doublet.

10 16. The method as set forth in claim 12 wherein the combining comprises adding or subtracting the time scaled and time delayed base signal with the other one of the pair of base signals to form the doublet.

15 17. The method as set forth in claim 12 further comprising:
 substantially assuring that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals prior to the transmitting; and
 substantially assuring that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals prior to the transmitting.

20 18. The method as set forth in claim 12 wherein the information comprises a message embedded prior to the transmission of the doublet.

25 19. The method as set forth in claim 12 wherein the information comprises imaging data embedded by an environment in which the doublet was transmitted.

30 20. The method as set forth in claim 12 wherein the receiving further comprises:
 segmenting the received doublet to form received segments;
 applying at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;

applying at least one of the plurality of time delays to each of the received segments to form time delayed signal segments;

multiplying each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals;

5 integrating the multiplied signals across time to form detection
signals; and

processing the detection signals at different ones of the plurality of time scales and different ones of the plurality of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the information from the determined detection signal.

21. The method as set forth in claim 20 further comprising:
substantially assuring that signal energy of the pair of substantially
15 matched base signals is evenly distributed across the duration of the pair of
substantially matched base signals following the receiving; and
substantially assuring that the signal energy is evenly distributed
across the spectrum of the pair of substantially matched base signals following the
receiving.

20 22. A modulation/demodulation system comprising:
a transmission system which applies one of a plurality of time
scales to one of a pair of substantially matched base signals, combines the time
scaled base signal with the other one of the pair of base signals to form a doublet,
25 and transmits the doublet; and
a receiving system which receives the doublet and extracts
information from the doublet based on the one of the plurality of time scales
which was applied.

30 23. The system as set forth in claim 22 wherein the transmission system further comprises a pair of synchronized and spatially separated radiating elements, one radiating element radiates one of the substantially matched base signals and the other radiating element radiates the time scaled base signal; and

24. The system as set forth in claim 22 wherein the transmission system further comprises:

- 5 a signal generator which generates the pair of substantially matched base signals;
- 10 an encoder which modulates the one of the plurality of time scales onto the one of the pair of substantially matched base signals;
- 15 a combiner which combines the time scaled base signal with the other one of the pair of base signals to form the doublet; and
- 20 a transmitter which transmits the doublet.

25. The system as set forth in claim 22 wherein the transmission system has a plurality of doublets with an independent one of the plurality of time scales applied to each doublet, the transmission system combines all of the doublets to form a composite signal, and transmits the composite signal; and

15 wherein the receiving system receives the composite signal and extracts the information from each of the doublets that comprise the composite signal based on the respective time scales applied to each of the doublets.

20 26. The system as set forth in claim 23 wherein the combiner is an adder or a subtractor.

25 27. The system as set forth in claim 22 wherein the transmission system further comprises:

15 a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signal; and

20 a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals.

30 28. The system as set forth in claim 22 wherein the information comprises a message embedded by the transmission system.

29. The system as set forth in claim 22 wherein the information comprises imaging data embedded by an environment in which the doublet was transmitted.

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30. The system as set forth in claim 22 wherein the receiving system further comprises:

a segmentation device that receives the doublet and forms received segments from the received doublet;

10 a time scaling device which applies at least one of the plurality of time scales to each of the received segments to form time scaled signal segments; and

15 a processing system which compares the time scaled signal segments at different ones of the plurality of time scales over time to determine the applied one of the plurality of time scales to extract the information from the detection signal.

31. The system as set forth in claim 22 wherein at least one of the pair of substantially matched base signals contains the information and the receiving system extracts the information from the one of the pair of substantially matched base signal in the doublet with the information..

32. A modulation/demodulation method comprising:

20 applying one of a plurality of time scales to one of a pair of substantially matched base signals;

25 combining the time scaled base signal with the other one of the pair of base signals to form a doublet;

30 transmitting the doublet into the environment;

receiving the doublet; and

extracting information from the doublet based on the one of the plurality of time scales which was applied.

33. The method as set forth in claim 32 further comprising further comprising providing a plurality of doublets with each of the doublets having an independent one of the plurality of time scales, combining all of the doublets to form a composite signal, transmitting the composite signal into the environment, 5 receiving the composite signal, and extracting the information from the doublets that comprise the composite signal based on the respective one of the plurality of time scales applied to each of the doublets.

34. The method as set forth in claim 32 further comprising extracting 10 the information from the one of the pair of substantially matched base signals in the doublet.

35. The method as set forth in claim 32 wherein the combining comprises adding the time scaled base signal with the other one of the pair of base 15 signals to form the doublet.

36. The method as set forth in claim 32 wherein the combining comprises subtracting the time scaled base signal with the other one of the pair of base signals to form the doublet.

20 37. The method as set forth in claim 32 further comprising: substantially assuring that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals prior to the transmitting; and 25 substantially assuring that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals prior to the transmitting.

38. The method as set forth in claim 32 wherein the information 30 comprises a message embedded prior to the transmission of the doublet.

39. The method as set forth in claim 38 wherein the information comprises imaging data embedded by an environment in which the doublet was transmitted.

5 40. The method as set forth in claim 32 wherein the receiving further comprises:

segmenting the received doublet to form received segments;

applying at least one of the plurality of time scales to each of the received segments to form time scaled signal segments; and

10 processing the time scaled signal segments at different ones of the plurality of time scales over time to determine the applied one of the plurality of time scales to extract the information from the determined time scaled signal segments signal.

15 41. The method as set forth in claim 32 further comprising:
substantially assuring that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals following the receiving; and

20 substantially assuring that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals following the receiving.

42. A transmission system for transmitting information comprising:
an encoding system which applies one of a plurality of time scales to one of a pair of substantially matched base signals;
a combiner which combines the time scaled base signal with the other one of the pair of base signals to form a doublet; and
a transmitter which transmits the doublet with the information.

30 43. The system as set forth in claim 42 wherein the encoding system has a plurality of doublets with an independent one of the plurality of time scales applied to each of the doublets, the combiner combines all of the doublets to form a composite signal, and transmits the composite signal;

44. The system as set forth in claim 42 wherein the transmission system further comprises a signal generator which generates the pair of substantially matched base signals and the encoding system comprises a first encoder which modulates the one of the plurality of time scales onto the one of the pair of substantially matched base signals and a second encoder which modulates the one of the plurality of time delays onto the one of the pair of substantially matched base signals.

10 45. The system as set forth in claim 42 wherein the combiner is an adder.

46. The system as set forth in claim 42 wherein the combiner is a subtractor.

15 47. The system as set forth in claim 42 further comprising:
a temporal equalizer which substantially assures that signal energy
of the pair of substantially matched base signals is evenly distributed across the
duration of the pair of substantially matched base signal; and
20 a spectral equalizer which substantially assures that the signal
energy is evenly distributed across the spectrum of the pair of substantially
matched base signals.

48. A method for transmitting information comprising:
25 applying one of a plurality of time scales to one of a pair of
substantially matched base signals;
combining the time scaled with the other one of the pair of base
signals to form a doublet with the information; and
transmitting the doublet.

30 49. The method as set forth in claim 48 further comprising:
radiating one of the substantially matched base signals from one of
a pair of synchronized and spatially separated radiating elements; and

radiating the time scaled and time delayed base signal from another one of the pair of synchronized and spatially separated radiating elements.

50. The method as set forth in claim 48 further comprising providing a plurality of doublets with each of the doublets having an independent one of the plurality of time scales, combining all of the doublets to form a composite signal, and transmitting the composite signal into the environment.

51. The method as set forth in claim 48 further comprising applying one of a plurality of time delays to the one of the pair of substantially matched base signals.

52. The method as set forth in claim 48 further comprising imbedding the information in one of the pair of substantially matched base signals in the
15 doublet.

53. The method as set forth in claim 48 wherein the combining comprises adding or subtracting the time scaled base signal with the other one of the pair of base signals to form the doublet.

20 54. The method as set forth in claim 48 further comprising:
substantially assuring that signal energy of the pair of substantially
matched base signals is evenly distributed across the duration of the pair of
substantially matched base signals prior to the transmitting; and
25 substantially assuring that the signal energy is evenly distributed
across the spectrum of the pair of substantially matched base signals prior to the
transmitting.

55. A receiver system for receiving transmitted information
30 comprising:
a receiver which receives a doublet; and

a processing system which extracts the information from the doublet based on one of a plurality of time scales which was applied to the doublet prior to transmission.

5 56. The system as set forth in claim 55 wherein the receiver further comprises a device that time scales a received signal from the doublet by the time scale that was applied to form a time scaled version of the received signal, a correlator that correlates the received signal with the time scaled version of the received signal to form a time delay correlation signal, a detector that detects the peaks of this time delay correlation signal, and an estimator that uses the time delay locations of the peaks to estimate the angle of arrival of each of the received signals.

10 57. The receiver system as set forth in claim 55 wherein the receiver receives a plurality of the doublets in a composite signal and the processing system extracts the information from the composite signal based on the one of the plurality of time scales which was applied to each of the doublets.

15 58. The system as set forth in claim 55 wherein the processing system also extracts the information from the doublet based on one of a plurality of time delays which was applied to the doublet prior to transmission.

20 59. The system as set forth in claim 55 wherein the processing system further comprises:

25 a segmentation device that receives the doublet and forms received segments from the received doublet;
 a time scaling device which applies at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;
 a time delaying device which applies at least one of the plurality of time delays to each of the received segments to form time delayed signal segments;

a multiplier which multiplies each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals; and

5 an integrator which integrates the multiplied signals across time to form detection signals, the processing system comparing the detection signals at different ones of the plurality of time scales and different ones of the plurality of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the information from the detection signal.

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60. The system as set forth in claim 55 wherein the receiver further comprises:

15 a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals; and

a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals.

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61. A receiving method for receiving information comprising:

receiving a doublet; and

extracting information from the doublet based on one of a plurality of time scales which was applied to the doublet.

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62. The method as set forth in claim 61 further comprising receiving a plurality of the doublets contained in a composite signal and extracting information from the composite signal based on the one of the plurality of time scales which was applied to each of the doublets.

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63. The method as set forth in claim 61 wherein the extraction is also based on one of a plurality of time delays which was applied to the doublet.

64. The method as set forth in claim 61 wherein the information comprises a message embedded prior to the transmission of the doublet.

65. The method as set forth in claim 61 wherein the information 5 comprises imaging data embedded by an environment in which the doublet was transmitted.

66. The method as set forth in claim 61 wherein the extracting further comprises:

10 segmenting the received doublet to form received segments;
applying at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;
applying at least one of the plurality of time delays to each of the received segments to form time delayed signal segments;
15 multiplying each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals; and
integrating the multiplied signals across time to form detection signals, wherein the extracting further comprises processing the detection signals at different ones of the plurality of time scales and different ones of the plurality 20 of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the information from the determined detection signal.

67. The method as set forth in claim 61 further comprising:
25 substantially assuring that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals following the receiving; and
substantially assuring that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals following the 30 receiving.

68. The method as set forth in claim 61 further comprising extracting the information from the one of the pair of substantially matched base signals in the doublet.

5 69. A communication system comprising:
a transmission system embeds communication information by applying one of a plurality of time scales and one of a plurality of time delays to one of a pair of substantially matched base signals, combines the time scaled and time delayed base signal with the other one of the pair of base signals to form a 10 doublet, and transmits the doublet; and

a receiving system which receives the doublet and extracts information from the doublet based on the one of the plurality of time scales and the one of the plurality of time delays which were applied.

15 70. The system as set forth in claim 69 wherein the transmission system further comprises:

a signal generator which generates the pair of substantially matched base signals;

20 an encoding system embeds the communication information by modulating the one of the plurality of time scales and the one of the plurality of time delays onto the one of the pair of substantially matched base signals;

a combiner which combines the time scaled and time delayed base signal with the other one of the pair of base signals to form the doublet; and

25 a transmitter which transmits the doublet.

71. The system as set forth in claim 69 wherein the transmission system has a plurality of doublets with an independent one of a plurality of the time scales and independent one of the plurality of time delays applied to each of the doublets, the transmission system combines all of the doublets to form and 30 transmit a composite signal; and

wherein the receiving system receives the composite signal and extracts the information from each of the doublets that comprise the composite

signal based on the respective one of the plurality of time scale and the one of the plurality of time delay that were applied to each of the doublets.

72. The system as set forth in claim 69 wherein the at least one of the 5 pair of substantially matched base signals contains additional information and the receiving system extracts the additional information from the at least one of the pair of substantially matched base signals in the doublet with the additional information.

10 73. The system as set forth in claim 70 wherein the combiner is an adder or a subtractor.

74. The system as set forth in claim 69 wherein the transmission system further comprises:

15 a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signal; and
a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially 20 matched base signals.

75. The system as set forth in claim 69 wherein the receiving system further comprises:

25 a segmentation device that receives the doublet and forms received segments from the received doublet;
a time scaling device which applies at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;
a time delaying device which applies at least one of the plurality of time delays to each of the received segments to form time delayed signal 30 segments;
a multiplier which multiplies each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals;

an integrator which integrates the multiplied signals across time to form detection signals; and

5 a processing system which compares the detection signals at different ones of the plurality of time scales and different ones of the plurality of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the communication information from the detection signal.

76. The system as set forth in claim 75 wherein the receiving system
10 further comprises:

a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals; and
15 a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals.

77. A method for communicating comprising:
applying one of a plurality of time scales and one of a plurality of
20 time delays to one of a pair of substantially matched base signals to embed communication information;
combining the time scaled and time delayed base signal with the other one of the pair of base signals to form a doublet;
transmitting the doublet into the environment;
25 receiving the doublet; and
extracting the communication information from the doublet based on the one of the plurality of time scales and on the one of the plurality of time delays which were applied.

30 78. The method as set forth in claim 77 further comprising providing a plurality of doublets with each of the doublets having an independent one of the plurality of time scales and an independent one of the plurality of time delays applied to each of the doublets to embed the communication information,

combining all of the doublets to form a composite signal, transmitting the composite signal into the environment, receiving the composite signal, and extracting the communication information from the doublets that comprise the composite signal based on the respective one of the plurality of time scales and 5 one of the plurality of time delays which were applied to each of the doublets.

79. The method as set forth in claim 77 further comprising imbedding additional information in one of the pair of substantially matched base signals in the doublet.

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80. The method as set forth in claim 77 wherein the combining comprises adding or subtracting the time scaled and time delayed base signal with the other one of the pair of base signals to form the doublet.

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81. The method as set forth in claim 77 further comprising:

substantially assuring that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals prior to the transmitting; and

substantially assuring that the signal energy is evenly distributed 20 across the spectrum of the pair of substantially matched base signals prior to the transmitting.

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82. The method as set forth in claim 77 wherein the receiving further comprises:

segmenting the received doublet to form received segments;

applying at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;

applying at least one of the plurality of time delays to each of the received segments to form time delayed signal segments;

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multiplying each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals;

integrating the multiplied signals across time to form detection signals; and

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processing the detection signals at different ones of the plurality of time scales and different ones of the plurality of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the communication information from the determined detection signal.

83. The method as set forth in claim 82 further comprising:
substantially assuring that signal energy of the pair of substantially
matched base signals is evenly distributed across the duration of the pair of
substantially matched base signals following the receiving; and
substantially assuring that the signal energy is evenly distributed
across the spectrum of the pair of substantially matched base signals following the
receiving.

15 84. An imaging system comprising:
a transmission system which applies one of a plurality of time
scales and one of a plurality of time delays to one of a pair of substantially
matched base signals, combines the time scaled and time delayed base signal with
the other one of the pair of base signals to form a doublet, and transmits the
20 doublet into an environment which embeds imaging information in the doublet;
and
a receiving system which receives the doublet and extracts the
imaging information from the doublet based on the one of the plurality of time
scales and the one of the plurality of time delays which were applied.

25 85. The system as set forth in claim 84 wherein the transmission
system further comprises:

30 a signal generator which generates the pair of substantially matched base signals;

an encoding system which modulates the one of the plurality of time scales and the one of the plurality of time delays onto the one of the pair of substantially matched base signals;

a combiner which combines the time scaled and time delayed base signal with the other one of the pair of base signals to form the doublet; and
a transmitter which transmits the doublet into the environment which embeds the imaging information.

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86. The system as set forth in claim 84 wherein the transmission system has a plurality of doublets with an independent one of a plurality of the time scale and independent one of the plurality of time delay applied to each of the doublets, combines all of the doublets to form a composite signal, and
10 transmits the composite signal; and

wherein the receiving system receives the composite signal and extracts the information from each of the doublets that comprise the composite signal based on the respective one of the plurality of time scale and the one of the plurality of time delay that were applied to each of the doublets.

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87. The system as set forth in claim 85 wherein the transmission system further comprises a pair of synchronized and spatially separated radiating elements, one radiating element radiates one of the substantially matched base signals and the other radiating element radiates the time scaled and time delayed
20 base signal into the environment which embeds the imaging information; and

wherein the receiving system further comprises a device that time scales a received signal by the time scale that was applied by the transmission system to form a time scaled version of the received signal, a correlator that correlates the received signal with the time scaled version of the received signal to
25 form a time delay correlation signal, a detector that detects the peaks of this time delay offset correlation signal, and an estimator that uses the time delay offset locations of the peaks to estimate the angle of arrival of each of the received signals.

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88. The system as set forth in claim 85 wherein the combiner is an adder or a subtractor.

89. The system as set forth in claim 84 wherein the transmission system further comprises:

5 a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signal; and

10 a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals.

15 90. The system as set forth in claim 84 wherein the receiving system further comprises:

20 a segmentation device that receives the doublet and forms received segments from the received doublet;

25 a time scaling device which applies at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;

30 a time delaying device which applies at least one of the plurality of time delays to each of the received segments to form time delayed signal segments;

35 a multiplier which multiplies each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals;

40 an integrator which integrates the multiplied signals across time to form detection signals; and

45 a processing system which compares the detection signals at different ones of the plurality of time scales and different ones of the plurality of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the imaging information from the detection signals.

50 91. The system as set forth in claim 90 wherein the receiving system further comprises:

a temporal equalizer which substantially assures that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals; and

5 a spectral equalizer which substantially assures that the signal energy is evenly distributed across the spectrum of the pair of substantially matched base signals.

92. A method for imaging comprising:
applying one of a plurality of time scales and one of a plurality of
10 time delays to one of a pair of substantially matched base signals;

combining the time scaled and time delayed base signal with the other one of the pair of base signals to form a doublet;

transmitting the doublet into the environment that embeds the imaging information;

receiving the doublet; and
extracting the imaging information from the doublet based on

15 receiving the doublet; and

extracting the imaging information from the doublet based on the one of the plurality of time scales and on the one of the plurality of time delays which were applied.

20 93. The method as set forth in claim 92 further comprising:

radiating one of the substantially matched base signals from one of a pair of synchronized and spatially separated radiating elements;

radiating the time scaled and time delayed base signal from another one of the pair of synchronized and spatially separated radiating elements;

25 time scaling a received signal by the time scale that was applied to
form a time scaled version of the received signal;

correlating the received signal with the time scaled version of the received signal to form a time delay correlation signal;

30 detecting the peaks of this time delay correlation signal; and
using the time delay locations of the peaks to estimate the angle of
arrival of each of the received signals.

94. The method as set forth in claim 93 further comprising providing a plurality of doublets with each of the doublets having an independent one of the plurality of time scales and an independent one of the plurality of time delays applied to each of the doublets, combining all of the doublets to form a composite signal, transmitting the composite signal into the environment which embeds the imaging information, receiving the composite signal, and extracting the imaging information from the doublets that comprise the composite signal based on the respective one of the plurality of time scales and one of the plurality of time delays which were applied to each of the doublets.

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95. The method as set forth in claim 92 wherein the combining comprises adding or subtracting the time scaled and time delayed base signal with the other one of the pair of base signals to form the doublet.

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96. The method as set forth in claim 92 further comprising:
substantially assuring that signal energy of the pair of substantially matched base signals is evenly distributed across the duration of the pair of substantially matched base signals prior to the transmitting; and

20 across the spectrum of the pair of substantially matched base signals prior to the transmitting.

97. The method as set forth in claim 92 wherein the receiving further comprises:

25 segmenting the received doublet to form received segments;
applying at least one of the plurality of time scales to each of the received segments to form time scaled signal segments;
applying at least one of the plurality of time delays to each of the received segments to form time delayed signal segments;
30 multiplying each of the time scaled signal segments with each of the time delayed signal segments to form multiplied signals;
integrating the multiplied signals across time to form detection signals; and

processing the detection signals at different ones of the plurality of time scales and different ones of the plurality of time delays over time to determine the applied one of the plurality of time scales and the applied one of the plurality of time delays to extract the imaging information from the determined detection signal.

5 98. The method as set forth in claim 97 further comprising:
substantially assuring that signal energy of the pair of substantially
matched base signals is evenly distributed across the duration of the pair of
10 substantially matched base signals following the receiving; and
substantially assuring that the signal energy is evenly distributed
across the spectrum of the pair of substantially matched base signals following the
receiving.